Angular distribution of total and polarimetric land surface reflectance measured by AirHARP

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The anisotropic total and polarized reflectance of a terrestrial surface are often characterized by the bidirectional reflectance and polarization distribution functions (BRDF and BPDF). A variety of semi-empirical BRDF and BPDF kernels have been developed. In real applications, these kernels are often used singly or linearly combined to form a BRDF or BPDF model. Proper consideration of such a model is important in remote sensing for both surface and atmospheric retrievals, especially for those from multi-angular backscatter and/or polarimetric measurements.

In this study, we aim to evaluate a few commonly used BRDF and BPDF models with the airborne Hyper-Angular Rainbow Polarimeter (AirHARP) measurements collected during the NASA Aerosol Characterization from Polarimeter and Lidar campaign in October – November 2017. AirHARP is the prototype instrument for HARP CubeSat and HARP2 satellite payloads designed at the University of Maryland Baltimore County (https://esi.umbc.edu), which measures radiance and polarization at 60 scan angles in the 670-nm wavelength and at 20 scan angles in each of other three bands (440, 550, and 870 nm), spanning a 114° along-track field of view. Those multi-angular measurements, as seen by AirHARP from a NASA ER2 aircraft, are used to infer surface BRDF and BPDF by means of an atmospheric correction determined from the Unified Linearized Vector Radiative Transfer Model [1,2] (https://unl-vrtm.org). In particular, the intensive AirHARP measurements over the California Rosamond Lake area are analyzed to characterize the angular distribution for total and polarized reflectance for both desert and vegetation surface types, which are used to validate the Ross–Li [3] and Rahman–Pinty–Verstraete [4] BRDF models, as well as the Maignan [5] BPDF model. The results provide a useful guidance for surface reflectance assumptions to be made in the aerosol retrieval algorithms not just for HARP family polarimeters but also for multi-angular polarimeters in general.

References

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